# Mark scheme

| Question | | | Answer/Indicative content | Marks | Guidance |
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| 1 | | | **1** percentage / absorbance / mean, higher ✓<br><br>**2** water / ice, expansion, breaks / damages, membrane **OR** ice crystals, puncture / damage, membrane ✓ | 2 (AO3.3) | **1 DO NOT ALLOW** absorption for 'absorbance'<br>**1 ALLOW** ORA percentage / absorbance / mean, lower, for first experiment / in table<br><br>**Examiner's Comments**<br><br>The command word 'suggest' provides a challenge for candidates to think creatively using their existing knowledge. A minority of candidates realised that the absorbance would be higher as more pigment would escape from the cells that had been frozen. Many candidates argued that freezing would make the membrane rigid and impermeable, preventing pigment loss, as they did not notice that the frozen beetroot was defrosted. Many candidates did not comment on the results (measured as absorbance in the colorimeter) as asked, but instead just commented on membrane permeability. Few candidates had the idea that when water freezes it both expands in volume, putting pressure on the cell surface membrane, and forms sharp ice crystals which can pierce the membrane. |
| | | | **Total** | **2** | |
| 2 | | | ***In summary**:*<br>*Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)*<br><br>*Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, **Level 1, Level 2** or **Level 3**, best describes the overall quality of the answer.*<br><br>*Then, award the higher or lower mark within the level, according to the* | 6 (AO1.1) | **Indicative points include:**<br><br>**Chemical properties**<br><br>• polar molecule<br>• unequal sharing of electrons / dipole<br>• Hydrogen is delta$^{+}$ / $\delta^{+}$ and oxygen delta $^{-}$/ $\delta^{-}$<br>• hydrogen bonds between water molecules<br>• hydrogen bonds / interactions are weak<br>• large number of bonds collectively strong |

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| | | | ***Communication Statement*** *(shown in italics):*<br><br>*award the higher mark where*<br>○ *the Communication Statement has been met.*<br>*award the lower mark where*<br>○ *aspects of the Communication Statement have been missed.*<br><br>• ***The science content determines the level.***<br>• ***The Communication Statement determines the mark within a level.***<br><br>**Level 3 (5–6 marks)**<br><br>An outline that includes chemical **and** physical property of water **and** example.<br><br>*There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*<br><br>**Level 2 (3–4 marks)**<br><br>An outline that includes chemical **or** physical property of water **and** example.<br><br>**OR**<br>An outline that includes chemical **and** physical property of water.<br><br>*There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*<br><br>**Level 1 (1–2 marks)**<br><br>An outline that includes **either** physical **or** chemical property of water **or** example.<br><br>*There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* | | • drawn diagram<br><br>**Physical properties**<br><br>• lower density of ice than liquid water so ice floats<br>• ice insulates (water below) / ice freezes from top down<br>• cohesion<br>• adhesion<br>• high surface tension<br>• (polar) solvent<br>• transparent<br><br>**Examples of how life is sustained**<br><br>• habitat for aquatic organisms<br>• buoyancy / support for (named) aquatic organisms e.g. fish / seaweeds<br>• obtaining dissolved oxygen<br>• organisms can survive beneath ice<br>• ice is habitat for e.g. polar bears<br>• ice provides resting / breeding areas for e.g. penguins / seals<br>• allow transpiration stream<br>• allows turgor pressure<br>• allows hydrostatic skeletons<br>• lubricant e.g. pleural fluid<br>• allows movement on water surface for e.g. pond skaters<br>• cytosol of eukaryotic / prokaryotic cells<br>• medium for chemical reactions<br>• allows transport of dissolved substances e.g. glucose in blood / e.g. dissolved nutrients in oceans<br>• allows removal of metabolic waste<br>• allows light to penetrate<br><br>**<u>Examiner's Comments</u>**<br><br>This question was generally very well answered. The chemical properties of water were less well covered than the physical properties and candidates who showed an understanding of the polarity of water molecules and/or the |

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| | | | **0 marks**<br><br>*No response or no response worthy of credit.* | | hydrogen bonding between molecules nearly always gained Level 3.<br><br>There was a good spread of answers concerning both physical properties and examples. There were very few examples given relating to hydrostatic skeleton, lubricant or cytosol. Most popular examples habitat for aquatic organisms and polar bears in reference to ice floating and insulating the water below, as were pond skaters.<br><br>The most common mistakes were to write about question stem references especially the thermal properties of water, sometimes at great length, or to confuse cohesion and adhesion or to refer to ice as being more dense than liquid water. There were some candidates who simply mentioned hydrogen bonds without making it clear that they were between water molecules or between water and other molecules. Other responses gave incorrect reference to charges on the water molecule.<br><br>**Assessment for learning**<br><br>Candidates often write too much for LoR questions with some completing several extra pages. Examiners appreciate how candidates want to demonstrate their knowledge, but they should be aware that marks are not given in proportion to the amount they write. It is important that candidates understand that a concise answer often achieves maximum marks. A good lesson in exam technique could be to encourage candidates to see if they can write a response and gain all 6 marks using only the space available.<br><br>**Misconception**<br><br>It is a common misconception that ice |

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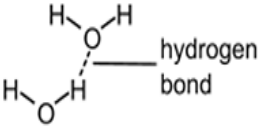
| | | | | | (water in solid form) is more dense than liquid water.<br><br>**Exemplar 2**<br><br>  <br>Water is polar and therefore makes a good solvent and transport medium. For example, the liquid part of the blood is primarily composed of water. Water is able to carry dissolved substances such as glucose and amino acids and bring them to cells. Water is also able to remove waste products, such as urea. Water is able to dissolve toxic substances. As well as this, water is used as a medium in chemical reactions. Water is used in photosynthesis and water is also used in hydrolysis reactions to break bonds. Water also has the property that ice is less dense than liquid water. This means that in ponds and lakes, the water doesn't freeze from the bottom up, enabling aquatic organisms to survive. Furthermore, the [6]<br>Additional answer space if required.<br>cohesive forces between water molecules allow small insects to walk on water and also aid for the transport of water in the xylem of plants as the column of water can travel up the xylem to the leaves without breaking.<br><br>A good Level 3 response is shown by this exemplar. The candidate completes their response in the space available. |
| | | | **Total** | **6** | |
| 3 | | i | water molecules correctly drawn ✓<br><br>horizontal / vertical, dashed line between **H** of one molecule and **O** of the adjacent molecule ✓<br><br>hydrogen bond labeled ✓ | 3 |  <br><br><br>**Examiner's Comments**<br><br>Many candidates were able to draw correct diagrams of two water molecules and most went on to gain full credit for both the bond and labelling. Occasional errors included water molecules with two oxygen atoms to one hydrogen and bonds drawn between two hydrogen atoms on separate molecules. |
| | | ii | cohesion, attracts / holds, water molecules together ✓<br><br>allows chain of water molecules to be pulled up xylem ✓<br><br>adhesion allows water molecules, to stick / AW, to xylem vessel walls ✓<br><br>(moving water up vessel) by capillary action ✓<br><br>(water as) a solvent to dissolve, sucrose / assimilates, for, transport in | Max 3 | **ALLOW** cohesion, water molecules form hydrogen bonds with each other |

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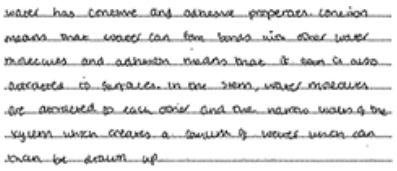
| | | | the phloem / translocation<br><br>**OR**<br><br>(water as) a solvent to dissolve ions for transport in the, xylem / transpiration stream ✓ | | **ALLOW** named ions /correct ion formulae<br><br>**Examiner's Comments**<br><br>There was a lot of good knowledge about the properties of water, but the wording used often lacked scientific precision. In particular many candidates had an understanding of both cohesion and adhesion. However, answers were imprecise and often did not relate to the role of water as a transport medium in plants. Many candidates did not specify that water 'molecules' stick together or that water 'molecules' adhere to the walls of the xylem. Very few candidates mentioned specific transport vessels merely saying things like 'water forms a column that allows it to move up the stem.<br><br>Some candidates included properties of water unrelated to transport functions such as specific heat capacity.<br><br>**Misconception**<br><br>Some candidates have a basic misunderstanding of solutions and wrote phrases such as 'water is soluble' while others wrote about water 'wanting' to go up the stem. This was the same with Question 24.<br><br>**Exemplar 3**<br><br>  <br><br>The exemplar shows a clear script that uses scientific terms correctly. |
| | | | **Total** | **6** | |